REVISED Toxicological Assessment of ISS Air Quality: May 2012 – August 2012

A summary of the analytical results from 12 grab sample containers (GSCs) collected on ISS and returned aboard 30S is shown in Table 1. The average recoveries of the 3 surrogate standards from the GSCs were as follows: ^{13}C-acetone, 115 ± 11%; fluorobenzene, 108 ± 8%; and chlorobenzene, 102 ± 16%. Shaded rows indicate data that are limited due to low sample pressures. For completeness, previously reported data from the US Lab collected in May 2012 are included here as well.

This revised report provides results from one returned sample that was unlabeled and originally assumed to be unused. The sample was prepared and analyzed for the purpose of measuring the surrogate compounds. It was later determined, based on serial number, that this was the HTV3 first ingress sample. All standard analytical protocols were followed for this sample with the exception of measuring the initial pressure. The dilution factor was estimated by calculating the average difference between measured cabin pressure and measured GSC initial pressures for the samples collected in May, July, and August and subtracting this value from the measured ISS cabin pressure on the date the HTV3 first ingress sample was collected.

Table 1. Analytical Summary of ISS results

Sample Location	Sample Date	NMVOCs[a] (mg/m^3)	Freon 218 (mg/m^3)	CO_2 (mg/m^3)	Alcohols (mg/m^3)	T Value[b] (units)
Lab[c]	5/29/2012	16	31	5700	6.8	0.42
SM	5/29/2012	18	24	8000	7.3	0.56
JPM	5/29/2012	19	26	6800	6.8	0.61
Lab	6/29/2012	15	24	5500	9.8	0.69
SM	6/29/2012	13	26	5500	8.6	0.54
Columbus	6/29/2012	15	26	5700	7.2	0.97
Lab	7/17/2012	9.6	26	3800	5.2	0.53
SM	7/17/2012	9.4	28	3400	5.0	0.52
JPM	7/17/2012	9.8	29	3100	5.3	0.55
HTV3 first ingress[d]	7/28/2012	14	12	2800	3.9	1.47 (0.98)
Lab	8/21/2012	9.2	25	4900	4.7	0.57
SM	8/21/2012	8.2	24	5000	3.9	0.53
Columbus	8/21/2012	8.6	23	5300	4.1	0.57
Guideline		*<25*	---	*<9300*	*<5*	*<1*

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218
[b] Based on 180-d SMACs and calculated excluding CO_2; parentheses indicate value based on 7-day SMACs
[c] previously reported – returned on 29S
[d] unlabeled sample – later identified as HTV3 first ingress sample; estimated dilution factor = 1.39

Toxicological Evaluation of ISS Air Quality: Routine monthly sampling provides a very limited set of samples on which to perform an air quality assessment. However, based on these samples, there is no concern for crew health. The primary contributor to the total T-value across all sampling locations throughout this time period was hexamethylcyclotrisiloxane. This compound was measured below levels of health concern; however, it may contribute to periodic accumulation of siloxanes in the water recovery system.

The CO_2 and Freon 218 levels measured in the HTV3 first ingress sample indicate that fairly substantial mixing occurred with the ISS atmosphere prior to sample collection. The slightly elevated T-value at

HTV3 first ingress was primarily attributed to trimethylsilanol, hexamethylcyclotrisiloxane, and methane. This result is consistent with the pre-flight off-gas test performed by JAXA. The measured T-value of 0.98 based on 7-day SMACs is lower than the predicted T-value of 1.72 resulting from the off-gas test; however, it is likely that some dilution occurred due to mixing with the ISS atmosphere prior to sample collection.

GSCs provide only a snapshot of conditions and are not ideal for evaluating potential CO_2 exposures. However, reported levels were below 4 mmHg (9300 mg/m^3), as requested for this Increment in Chit 10385.

The alcohol guideline (<5 mg/m^3) is intended to protect the water recovery system from risk of overloading. Relatively high alcohol values were reported in May and June. Ethanol was the primary cause of the high alcohol levels; however, we are not aware of a new source of this compound, and levels show a downward trend in July and August.

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Enclosures Table 1: Analytical concentrations of compounds found in the 30S GSCs
Table 2: T-values corresponding to analytical concentrations in Table 1.
Table 2A: HTV3 first ingress T-values based on 7-day and 180-day SMACs